Numerical modelling of the mechanics of off-shore structures

***†Nicholas Fantuzzi[1]**

[1]Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Italy.

*Presenting author: nicholas.fantuzzi@unibo.it
†Corresponding author: nicholas.fantuzzi@unibo.it

Abstract

Mechanics is needed in engineering design for understanding the physical behavior of structural components and structural systems. It has a broad applicability to many engineering fields which is able to approach problems in both research and industry. Structures in offshore environment require special attention due to the mutual presence of random loads such as wind, wave and earthquake just to cite a few. Structural complexity is not only due to load conditions but also to the introduction of new materials and industrial production processes. The present talk shows activities which have been carried out at Ravenna Campus of the University of Bologna, where an efficient network exists between industrial and local authorities.

The present paper deals with the numerical modelling oriented to the understanding of the mechanics of some key components in offshore structures such as pistons, flexible pipelines, smart devices and composite structures. Buckling of structural components is a fundamental verification in any engineering practice. In offshore engineering such problem is of paramount importance due to the presence of high loads, for instance, tip loads applied to pistons and internal pressure in pipelines conveying highly pollutant fluids. Some problems related to the buckling of slender elements as composite beams and flexible pipelines are still open topics. When composite materials are used for novel engineering applications the most common problem is how such new structures can be suited for classical engineering practices. This aspect will be discussed with a theoretical/numerical procedure for the identification of the mechanical properties and behavior of Fiber Reinforced Pultruded (FRP) beams in offshore environment. Vibration control in offshore structures is important to the presence of several dynamic environmental loads present at the same time. Vibration control using passive and semi-active smart devices will also be shown for simple structural modelling.

All problems are analyzed through numerical modelling always having a strong industrial reference and applicability. Comparisons with existing literature and commercial finite element packages are also shown in order to prove the validity of the present methodologies and their validity for industrial practices.

Keywords: Numerical modelling, Finite Element Method, Composite Structures, Smart Structures, Structural vibrations